

THE STATUS OF LOPHOTOCARPUS IN
WESTERN NORTH AMERICA

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In his treatment of the family Alismaceae, Kunth (1841) divided *Sagittaria* into three sections; the last of these was followed by the word, *Lophiocarpus*, in parentheses, which suggests that this name was intended in some subgeneric status. No names were assigned to the other two sections. In *Lophiocarpus* were included *S. cordifolia* Roxb. from Calcutta, *S. guyanensis* HBK. from near Angustura in Guiana, and *S. echinocarpa* Mast. from Pará, Brazil.

Miquel (1871, p. 50) used the name *Lophiocarpus* in a generic sense and transferred *S. cordifolia* Roxb. to it.

In his monographic treatment of the family Alismaceae, Micheli (1881) also adopted the name *Lophiocarpus*, referring it back directly to Kunth rather than to Miquel through *L. cordifolia*. In this work Micheli transferred the North American *Sagittaria calycina* Engelm. to the genus *Lophiocarpus*.

Lophiocarpus was recognized by Th. Durand (1888) in the body of his text but he credited it to Micheli. Apparently before the work was complete he discovered the earlier *Lophiocarpus* Turcz. of the Chenopodiaceae and in the addenda proposed the name *Michelia* as a substitute. Before the index was prepared, however, Durand discovered that *Michelia* Th. Dur. was antedated by *Michelia* L. of Magnoliaceae. Therefore, in the index of his work, under the italicized entry *Lophiocarpus*, occurs the word *Lophotocarpus* Th. Dur. in ordinary type and in parentheses. This, I believe, is valid publication of the epithet *Lophotocarpus* even though Durand erroneously credited the basic synonym *Lophiocarpus* to Micheli rather than to (Kunth) Miquel. Through the reference to Micheli, however, we are enabled to get back to the original use of *Lophiocarpus* by Kunth, and that is all that is really important. Buchenau (1889) published the account of Alismaceae in Engler and Prantl, *Die Natürlichen Pflanzenfamilien*, recognizing *Lophiocarpus* Miq. with serious misgivings as follows:—"Von *Sagittaria* kaum genügend verschieden."

In their treatment of the Alismaceae, in a "List of the Pteridophyta and Spermatophyta growing without cultivation in northeastern North America," Morong and Smith (1894) made the nomenclatural transfer of *Sagittaria calycina* Engelm. to *Lophotocarpus*. In so doing he misspelled one of the synonyms, thus erroneously crediting *Lophianthus*, a name that had not hitherto been published, to Micheli.

Smith, in a later work (1895, p. 28) treating of the Alismaceae in North America, discusses his reasons for this transfer. He stated his case as follows, "I have followed Buchenau and Micheli in separating the species of *Lophotocarpus* from

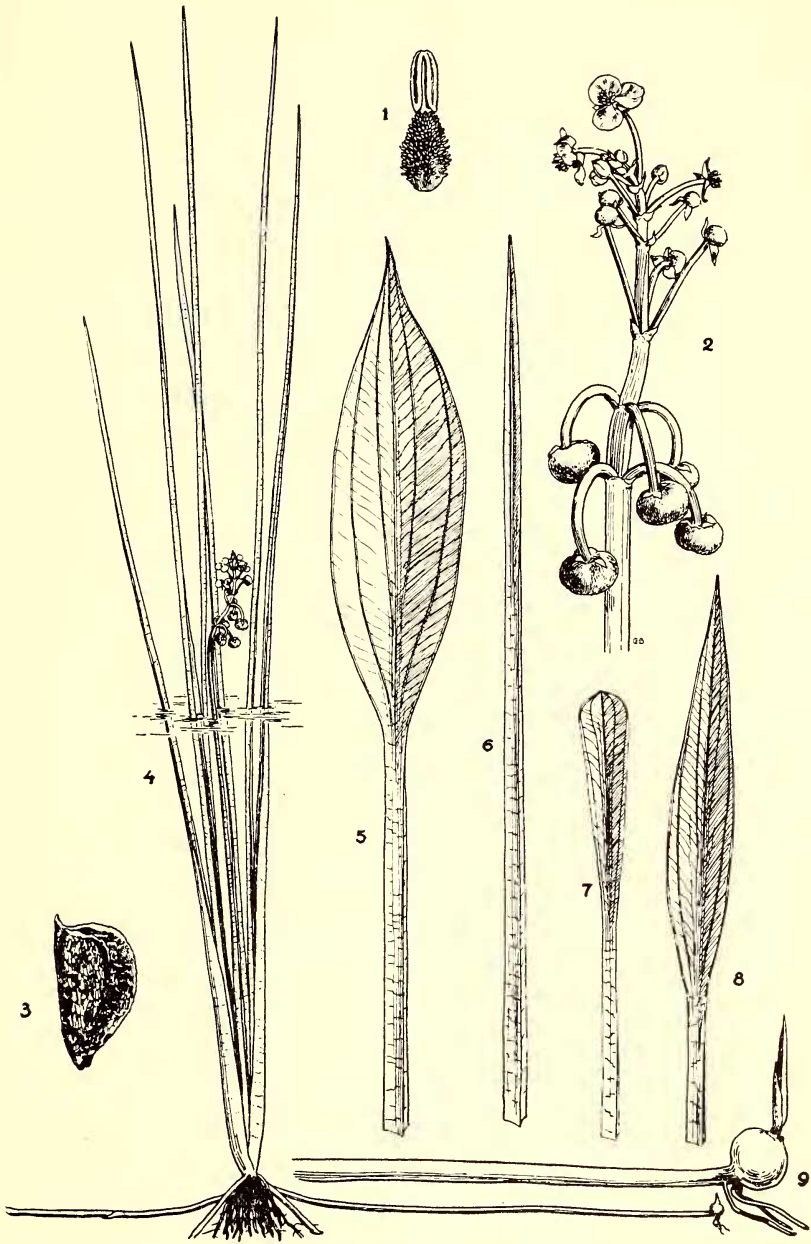
Sagittaria. *Lophotocarpus* is annual (at least our species), the flowers are perfect or staminate, and the stamens are hypogynous. *Sagittaria* is perennial, monoecious or dioecious with the fertile flowers never perfect, and the stamens are born above the receptacle." At the time the transfer was made, Smith construed the genus in the United States as involving a single species, *Lophotocarpus calycinus* (Engelm.) Smith, without varieties or subspecies, and gave Micheli as authority for another species, *L. guyanensis* (HBK.) Mich. from "Mexico, etc." In a still later treatment Smith (1899) recognized seven species within what he previously had regarded as *L. calycinus*. Of these, two were described as new: *L. californicus* and *L. spatulatus*.

With respect to the separation of *Lophotocarpus* from *Sagittaria* there are three points that we wish to raise. First, the differences suggested by Smith are apparently not of sufficient character to preclude confusion in their application by students. This is reflected in the haphazard identifications evident on the material in any herbarium. Secondly, the characters utilized are either not conclusive or they are misleading by virtue of the way they are expressed. These characters will be discussed momentarily. Thirdly, since our classification system is designed to express the natural relationship among plants, the morphological characters of *Lophotocarpus* that suggest its relationship to *Sagittaria* are such that, in the opinion of the writer, the genus cannot be removed from *Sagittaria* without taking with it other species not included by Smith. Such a disposition would result in completely unnatural genera. We shall now discuss the above points.

The first point is sufficiently clear as to warrant no further amplification. However, additional reasons for it will be apparent from the discussion of our second and third points. In segregating the two genera, Smith states that the stamens are "hypogynous" in *Lophotocarpus* while in *Sagittaria* they are "born above the receptacle." It is difficult to understand just what the author thought he saw in this supposed contrast. It is possible that this is only a direct translation of the phraseology of the key expressed in Latin by Micheli. In material that we have studied, the stamens are hypogynous in both *Lophotocarpus* and *Sagittaria*. Another character utilized by Smith is the occurrence of perfect and staminate flowers in *Lophotocarpus* and of pistillate and staminate flowers in *Sagit-*

EXPLANATION OF FIGURES 1-9.

FIGS. 1-9. *Sagittaria Sanfordii* Greene: 1, stamen, showing inflated hairs on filament, $\times 7$; 2, inflorescence, showing staminate flowers and fruit, $\times \frac{1}{2}$; 3, mature fruit, $\times 7$; 4, typical mature plant showing runner and perennating corm, $\times 1/10$; 5-8, variation in leaf blades, $\times \frac{1}{2}$; 9, sprouting corm, $\times \frac{2}{3}$. Figs. 1-4, 6, 9, based on Mason & Grant, 13001; fig. 5, based on Mason & Smith 8320; figs. 7, 8, based on Nobs & Smith 169. All from fresh material.



FIGS. 1-9. *Sagittaria Sanfordii* Greene.

taria, but frequent exceptions to such segregation of flower type seriously weaken the significance of such a character as being representative of a clearly fixed genetic difference such as should characterize genera. In some populations of *Sagittaria latifolia* as well as of *S. Greggii*, individuals are frequently encountered having either perfect and pistillate flowers, or the lower pistillate, the middle perfect, and the upper staminate. Likewise, individual specimens of *Lophotocarpus* with pistillate flowers have been observed. Further, Smith contrasts the "annual" habit of *Lophotocarpus* with the "perennial" habit of *Sagittaria*. It would have been better if the character used emphasized the development of perennating corms at the ends of the rhizomes in *Sagittaria* since in *Lophotocarpus* no such corms are produced. This would at least have placed the problem on a morphological basis and would thus eliminate a very obvious source of confusion owing to the fact that several species of *Sagittaria* are perennial or annual depending on the circumstances under which they grow. For example, *S. Greggii*, like most of the species, blooms the first year from seed. In the rice fields where this species is common, the water is drained off before the corms develop; so the plants reproduce only by seed. In some vernal pools this occurs naturally. This character raises an interesting technical point regarding plants that produce perennating structures other than the plant body upon which these structures are produced. Since each season's plant dies at the end of the season, are such plants any more perennial by virtue of asexual offsets than are plants that produce seed before they die? In each case the parent as an objective unit dies leaving one to several new, independent objective units each of which develops into a new plant. Obviously, this problem has many philosophical ramifications which are outside the scope of this paper.

When we compare *Lophotocarpus californicus* with the species of *Sagittaria*, our attention is immediately focused upon certain characters obviously in common with *Sagittaria Sanfordii* Greene. In both of these species the fruit is born on a recurved pedicel (figs. 2, 14, 18). In both, the filaments of the anthers are clothed with scaly inflated hairs (figs. 1, 15) which collapse and fall off when the specimen is dried. In both, some of the leaf blades are elliptic (figs. 5, 8, 11-13). In *S. Sanfordii* these represent the most highly developed leaves, the others

EXPLANATION OF FIGURES 10-19.

FIGS. 10-19. *Sagittaria calycina* Engelm.: 10-13, developmental stages from seedling to mature plant, $\times \frac{1}{3}$; 14, mature plant, $\times \frac{1}{5}$; 15, stamen showing inflated hairs on filament, $\times 7$; 16, pistillate flowers in young inflorescence, $\times \frac{1}{2}$; 17, young inflorescence showing subtending bracts, $\times \frac{1}{2}$; 18, inflorescence showing staminate flowers at apex and fruits below, $\times \frac{1}{2}$; mature fruits, $\times 5$. Figs. 10-13, based on Mason & Smith 8217; figs. 14-19, based on Mason & Smith 8322. All from fresh material.



FIGS. 10-19. *Sagittaria calycina* Engelm.

being bladeless. In *Lophotocarpus californicus* they represent the juvenile stages in the ontogenetic development of the individual plant. Both species begin flowering while still producing juvenile leaves, and usually each plant continues to produce inflorescences throughout the summer and early fall. The remainder of our Californian species of *Sagittaria* rarely produce more than two inflorescences. We are to weigh these characters against the so-called annual and perennial habit and the distribution of the sexes in the inflorescence, a condition which is not too well established in any of the related species. Obviously *Sagittaria Sanfordii* is more closely related to *Lophotocarpus californicus* than to any other species of *Sagittaria*. To place it in the genus *Lophotocarpus* would completely destroy the naturalness of *Lophotocarpus* in contrast to *Sagittaria*. Yet the concomitance of characters demands that however we may treat *Lophotocarpus californicus* generically, so must we treat *Sagittaria Sanfordii*. To place them together in *Lophotocarpus* destroys completely the character basis of the original reference of *S. calycina* to *Lophotocarpus* by Smith. Additional character differentiae do not warrant a rediagnosis of *Lophotocarpus* to include *S. Sanfordii*.

We therefore conclude that at least so far as *Sagittaria calycina* Engelm. and its segregates are concerned the objectives of taxonomy are best served by retaining them in *Sagittaria*.

To conclude these remarks we need only to clarify Smith's concept of *Lophotocarpus californicus* as distinct from *L. calycinus*. Our field experience in the western states makes it amply clear that there are no significant definable differences between what Smith set up as *L. californicus* and what he retained as *L. calycinus*. To serve as his nomenclatural type of *Lophotocarpus californicus*, Smith selected from the herbarium a slender individual such as may be found in any dense stand of these plants. The inflation of the dorsal wing of the achene is so variable in the achenes of any well-developed fruiting head that it lacks taxonomic significance. Both the inflated type of achene ascribed to *L. californicus* and the flat type of *L. calycinus* are to be found on any well developed fruiting head. The range of variation in the stature of the plant and the leaf pattern is enormous and gives evidence of representing stages in the ontogenetic development of the individual as well as ecological modifications. The fact that the plants begin blooming before they attain full maturity and continue to bloom throughout the season contributes to the wide variation in stature evident in the specimens preserved in herbaria.

Jepson (1912, pp. 79-80) recognized *Lophotocarpus calycinus* and rejected *L. californicus* Smith. He also listed as a synonym, *L. fluitans* Smith as represented by the illustration in Smith's paper. All of these epithets represent individuals

that are clearly within the range of variation evident in any large stand of *L. calycinus* in California.

The following synonymy represents our opinion as to the relationships of *Sagittaria calycina*:

Sagittaria calycina Engelm. in part. in Torr. Mex. Bound. Survey. II:212. 1859.

Lophiocarpus calycinus Micheli in DC. Monog. Phaner. 3: 61. 1881.

Lophotocarpus calycinus Smith, Rep. Mo. Bot. Gard. 6: 60. 1895.

Lophianthus calycinus Micheli (as an orthographic error) in Smith, Mem. Torrey Bot. Club 5: 25. 1894.

Lophotocarpus californicus J. G. Smith, Rep. Mo. Bot. Gard. 11: 146. 1899.

These studies have been made largely in the field and rest upon observations of living plants as they vary locally and geographically and as they vary with the progression of the season. Herbarium studies were utilized to vouchsafe the nomenclature and to arrive at an understanding of the concepts expressed in the previous literature based upon herbarium material. To document our facts the following California collections have been deposited in the Herbarium of the University of California at Berkeley:

Sagittaria calycina Engelm. Lassen County: State Fish and Game nesting area, west side of section 19, Madeline Plains, 1 August 1947, *Grant & Schneider 8222*; Colusa County: pond on Colusa-Marysville Highway, 4 miles south of Colusa, 6 August 1946, *Mason & Grant 12961*; 8 miles north of Colusa, 7 August 1946, *Mason & Grant 12981*; Sutter County: rice fields, Sutter By-pass, just south of Marysville, 29 July 1949, *Nobs & Smith 1100*; Sacramento County: irrigation ditch west of Rio Linda, 15 August 1946, *Mason & Grant 13007*; San Joaquin County: Daggett Road and Borden Highway, 12 September 1946, *Mason 13126*; between Banta and Stockton, 21 August 1946, *Mason & Grant 13057*; irrigation canal $\frac{1}{4}$ mile west of Stockton, 25 September 1948, *Nobs 692*; Merced County: alkaline stream 5 miles north of Volta, 29 June 1948, *Mason 13579*; 2 miles north of Volta, 6 July 1948, *Nobs & Smith 6*; vernal pool at north end of Los Banos Wildlife Refuge, 2 miles north of Los Banos, 9 July 1948, *Nobs & Smith 67*; $\frac{1}{4}$ mile south of Ingomar, 27 July 1948, *Mason & Smith 8217*; Crane Ranch, south of junction of Merced and San Joaquin rivers, 11 August 1948, *Mason & Smith 8322*.

Sagittaria Sanfordii Greene. Butte County: West Gridley road one mile west of Gridley, Pennington highway, 8 August 1946, *Mason & Grant 13001*; road between Gridley and Princeton, 4 September 1946, *Mason & Grant 13112*; Merced County: Los Banos Wildlife Refuge, 2 miles north of Los Banos, 19 July 1948, *Nobs & Smith 169*; Modesto Gun Club, 1 mile east of

Gustine, 24 August 1948, *Nobs & Smith* 429; Highway 33, 2.4 miles north of Dos Palos, 13 July 1949, *Nobs & Smith* 965; Mendota Pool, at entrance of Firebaugh canal, 10 August 1948, *Mason & Smith* 8318; Crane Ranch, south of junction of Merced and San Joaquin rivers, 11 August 1948, *Mason & Smith* 8320; Snelling highway, 2 miles northeast of Merced, 19 August 1948, *Mason & Smith* 8366.

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MR. PINCE'S MEXICAN PINE

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That's what Gordon (1858) called *Pinus Pinceana*, a rare Mexican pine of the pinyon group. It was originally discovered by M. Ghiesbreght "near the Hacienda del Potrees (?) in the ravine of Mestitlan [Barranca de Meztitlan?], State of Hidalgo." Ghiesbreght's specimen (no. 34) to which Gordon refers in his original description is in the Mexican collection at Paris, but has never been identified and named (Shaw, 1905). Martinez (1948) says that he could not verify this find-

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